




# Module 3.

Soil Handling and Fertility



## In this Section:

- Stripping
- Stock piling/Importing
- Spreading (Topsoiling)
- Testing
- Amending
  - Fertilizers
  - Compost



# Module 3a.

## Stripping

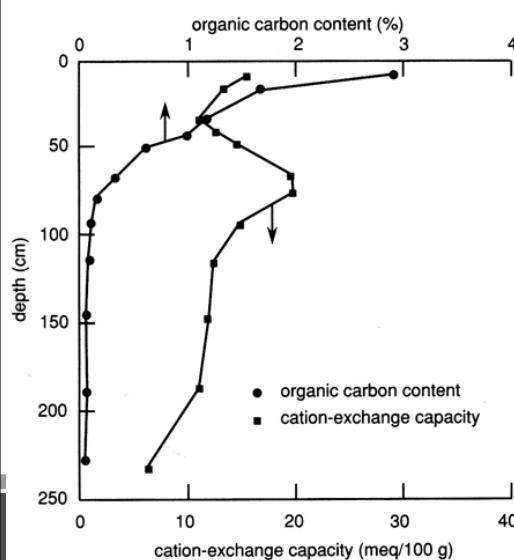


## Stripping

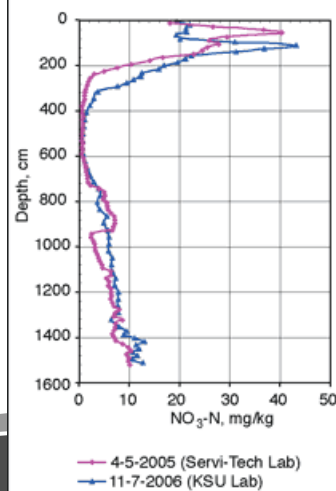
Soils have:

- Texture
- Structure
- Distribution profiles of different elements in the soil

## Distribution Profiles in Soil



Site R8, Measured soil  $\text{NO}_3\text{-N}$ : Spring 2005 and Fall 2006



## Clay Distribution in the Soil

Bulk Density, 15 Bar  
Bulk Density, One-Tenth Bar  
Bulk Density, One-Third Bar  
Linear Extensibility  
Liquid Limit  
Organic Matter

### Percent Clay

View Description View Rating

#### View Options

Map ☒  
Table ☒  
Description of Rating ☒  
Rating Options ☒  
☐ Detailed Description

#### Advanced Options

Aggregation Method: Dominant Component  
Component Percent Cutoff:   
Tie-break Rule: ☐ Lower ☒ Higher  
Interpret Nulls as Zero: ☐ Yes ☒ No  
Layer Options (Horizon Aggregation Method): ☐ Surface Layer (Not applicable) ☒ Depth Range (Weighted Average)  
Top Depth:  Bottom Depth:



**Warning: Soil Ratings Map may not be valid at this scale.**  
You have zoomed in beyond the scale at which the soil map for this area is intended to be used. Mapping of soils is done at a particular scale. The soil surveys that comprise your AOI were mapped at 1:15,800. The design of map units and the level of detail shown in the resulting soil map are dependent on that map scale. Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

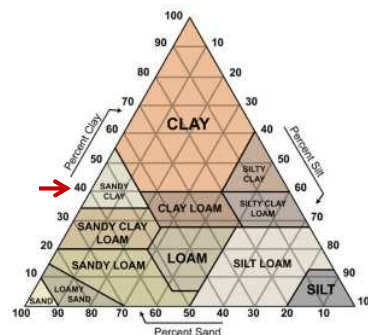
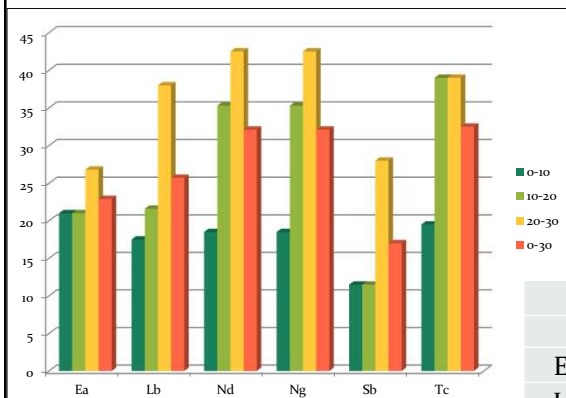
#### Tables - Percent Clay - Summary By Map Unit

##### Summary by Map Unit - Fluvanna County, Virginia (VA065)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
Ea	Elbert silt loam	26.8	2.0	19.3%
Lb	Lignum silt loam, undulating phase	38.0	2.4	22.5%
Nd	Nason silt loam, eroded rolling phase	42.5	4.6	43.0%
Ng	Nason silt loam, undulating phase	42.5	1.6	14.6%
Sb	Seneca silt loam	28.0	0.0	0.4%
Tc	Tatum silt loam, undulating phase	39.0	0.0	0.2%
<b>Totals for Area of Interest</b>			<b>10.6</b>	<b>100.0%</b>

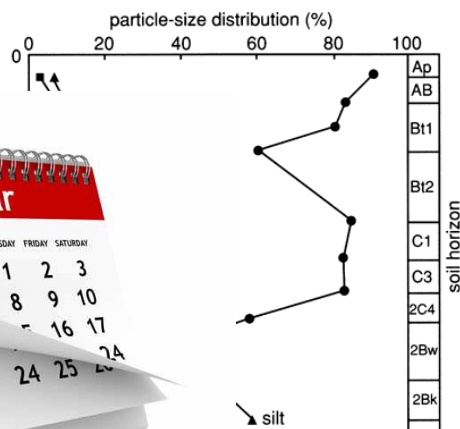
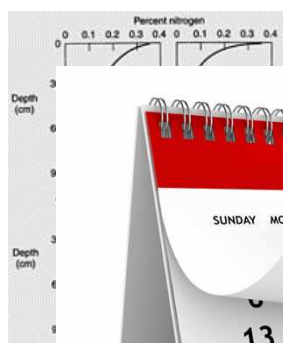
#### Description - Percent Clay

## Clay Distribution in the Soil



	% Clay			
	0-10 cm	10-20 cm	20-30 cm	0-30 cm
Ea	21	21	26.8	22.9
Lb	17.5	21.6	38	25.7
Nd	18.5	35.3	42.5	32.1
Ng	18.5	35.3	42.5	32.1
Sb	11.5	11.5	28	17
Tc	19.5	39	39	32.5

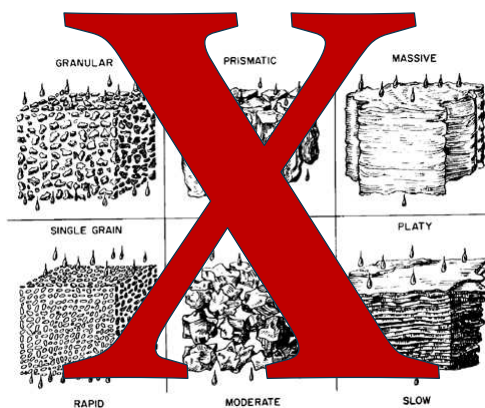
## Distribution Profiles in Soil



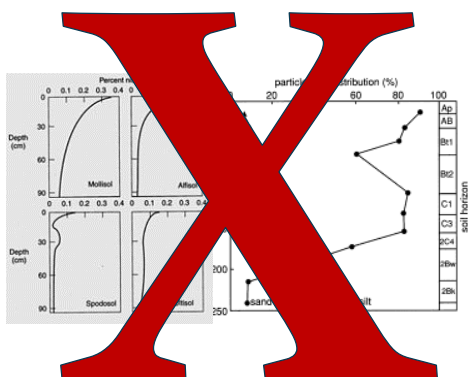
## What happens with stripping?



## What happens with stripping?



## What happens with stripping?



## What happens with stripping?



In some cases, this may take 50+/100+ years for the soil texture or distribution profiles to become re-established!



## Another Quote

We know more about the movement of celestial bodies than about the soil underfoot.

Leonardo Da Vinci



## Stripping Depth!

	% Clay			
	0-10 cm	10-20 cm	20-30 cm	0-30 cm
Ea	21	21	26.8	22.9
Lb	17.5	21.6	38	25.7
Nd	18.5	35.3	42.5	32.1
Ng	18.5	35.3	42.5	32.1
Sb	11.5	11.5	28	17
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## Infiltration Practices?

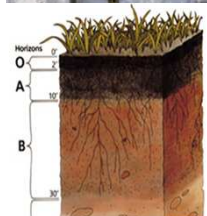
	% Clay			
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Sb	11.5	11.5	28	17
Tc	19.5	39	39	32.5



## Stripping Topsoil: ESC Standards and Specifications 3.30



- Do not strip topsoil when soil is wet or frozen



- Stripping depth of 4 – 6 inches ( $\approx$  O and A horizons)



- Place all perimeter controls prior to stripping the topsoil from a site



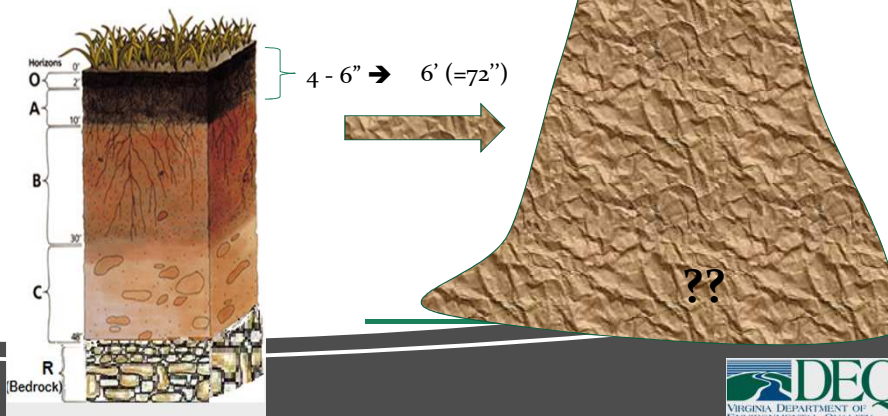


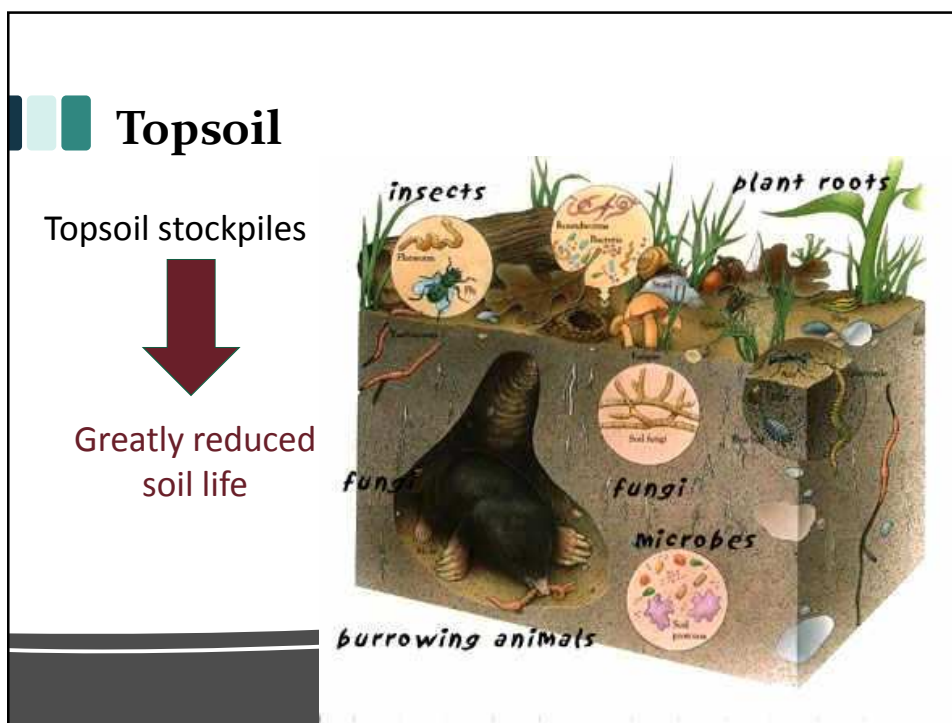
## Module 3b.

### Stockpiling



## Maintaining Soil Life in Topsoil Stock Piles





## Maintaining Soil Life in Topsoil Stock Piles

To maintain native soil life (microbial, fungal, mycorrhizae and other life) we need:

- Grow plants on the pile
- Best would be: native plants (native annuals???)

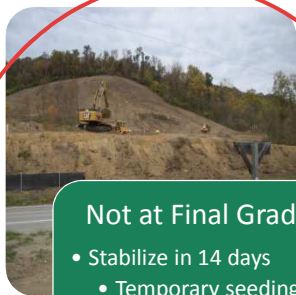
**Minimum  
Standards 2 and 1**

## MS-2 (Topsoil stockpiles)

- Soil stockpiles and borrow areas shall be stabilized or protected with sediment trapping measures
- Applies to on and off-site stockpiles and borrow areas

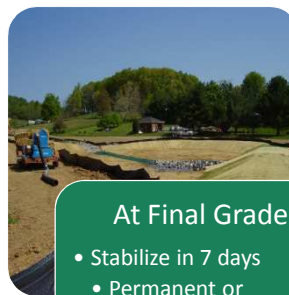


## MS-1 (Site stabilization)



### Not at Final Grade

- Stabilize in 14 days
  - Temporary seeding + Mulch
- Mulch
- Permanent stabilization if dormant > 1 year



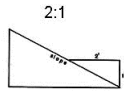
### At Final Grade

- Stabilize in 7 days
  - Permanent or Temporary Seeding + Mulch
- Mulch

**Also for Topsoil Stockpiles**



## Stockpiling Topsoil: ESC Standards and Specifications 3.30



- Stabilized and protect in accordance with MS-2
- Side slopes shall not exceed 2:1
- Perimeter controls should be placed immediately
- Seeding within 7 days if left dormant for more than 14 days in accordance with MS-1



## Seeding to Maintain Life in Topsoil Stock Piles

**Seeding is generally done with native annuals (Std. & Specs. 3.31)**

- Roots provide oxygen, carbon (organic matter) and other nutrients to microorganisms in the soil
- In the past literature suggested a cover crop of buckwheat



Buckwheat





## Remember

Seeding is not just done to meet some regulation or to prevent erosion!

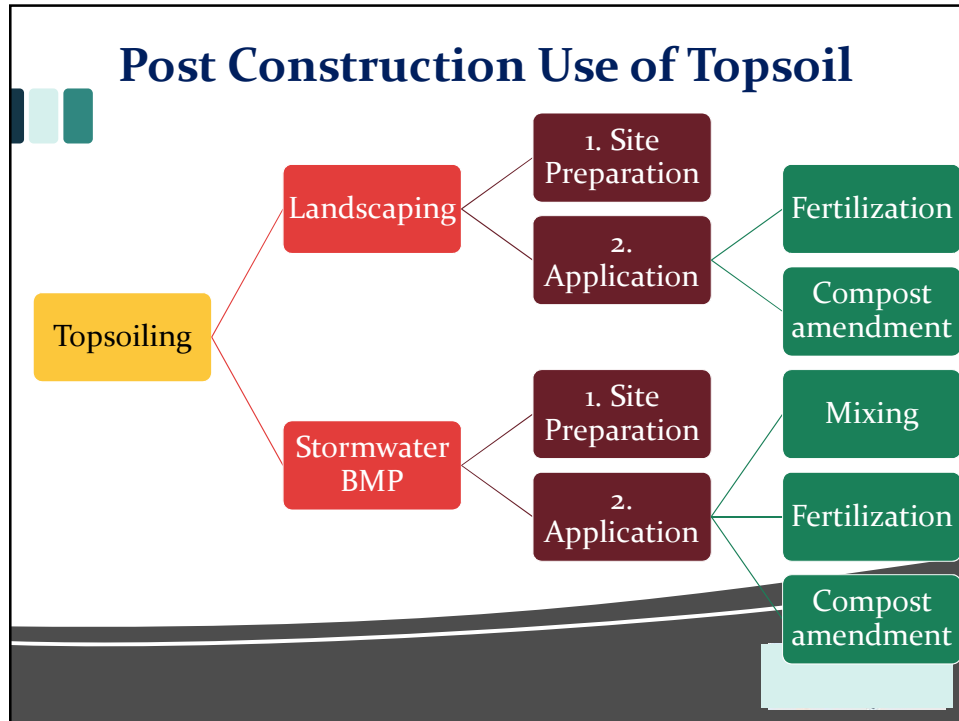
Plants helps in keeping the soil (biologically but also physically) healthy and improve the chances of revegetation success once the topsoil is reapplied to the site.







## Module 3c

Spreading (Topsoiling)






## Site Preparation Prior to Topsoiling: ESC Standards and Specifications 3.30

- Perimeter controls should be in place
- Grade subsoil
- Lime subsoil if very acid (pH<6.0)
- Loosen subsoil for bonding with topsoil



## Applying Topsoil: ESC Standards and Specifications 3.30



- Do not apply when soil is wet or frozen



- Minimum 2" deep on 3:1 or steeper slopes 4" on flatter slopes



- Avoid irregular surface (ponding)



- May need some compaction for good bonding with subsoil (avoid over-compaction)

## (Top)Soil and the BMP Clearinghouse

### Surface Infiltration

- Sheet flow
- Grass Channels
- Vegetated Roof
- Dry swale
- Extended Detention Pond (2)

### Subsurface Infiltration

- Permeable Pavement
- Infiltration
- Bioretention

### No Infiltration

- Rainwater Harvesting
- Filtering Practices

### Ponding

- Wet Swale
- Constructed Wetland
- Wet Pond
- Extended Detention Pond (1)

Rooftop disconnect



## 2. Sheet Flow

- Conserved Open Space → native soil = **No disturbance!**
- Vegetated Filter Strip → All soil types, **no** fill, **yes** topsoil

Topsoil Requirements	
Soil type	Loamy sand/sandy loam
Clay content	<5%
pH	6-7
Organic matter	≥ 2%
Salt	< 500 ppm
Depth	6-8" lightly compacted

When needing to import topsoil

## 3. Grass Channels

- Can be used on all soil types, with or without compost amendments
- Hydrologic soil groups C and D require compost amendments to improve performance
- No topsoil requirements in Standards and Specifications, but no reason not to use topsoil
- Protection of soil (infiltration ability) stressed!

## 10. Dry Swale

- Can be used on all soil types
- Hydrologic soil groups C and D require an underdrain
- Dry swales require a 4" **topsoil** layer on top of an engineered soil medium (Table 10.4) of at least 18" that is placed on top of choker stone layers on native soil
- Alternatively, use: 18" of sand on top of which is placed a 4" combination (mix?) of **topsoil** and leaf compost covered by turf



## 10. Dry Swale

Table 10.4

Topsoil Requirements	
Soil type	Loamy sand/sandy loam
Clay content	<5%
pH	6-7
Organic matter	≥ 2%
Salt	< 500 ppm
Depth	6-8" lightly compacted



## 15. Extended Detention Pond Level 2

- No recommendations for the use of topsoil
- Recommend using ESC Standards and Specifications for the use of topsoil (buffers, etc)



## SW BMPs Conclusion

- For most BMPs soil at siting is more important → infiltration (Module 7)
- Topsoil is utilized in two ways:
  1. Non-disturbed/restored
  2. To cover up an engineered medium




Add compost?



Import soil?


Topsoil Requirements	
Soil type	Loamy sand/sandy loam
Clay content	<5%
pH	6-7
Organic matter	≥ 2%
Salt	< 500 ppm
Depth	6-8" lightly compacted






# Module 3d

Soil Testing and Amending




## Plant nutrition: The essential nutrients

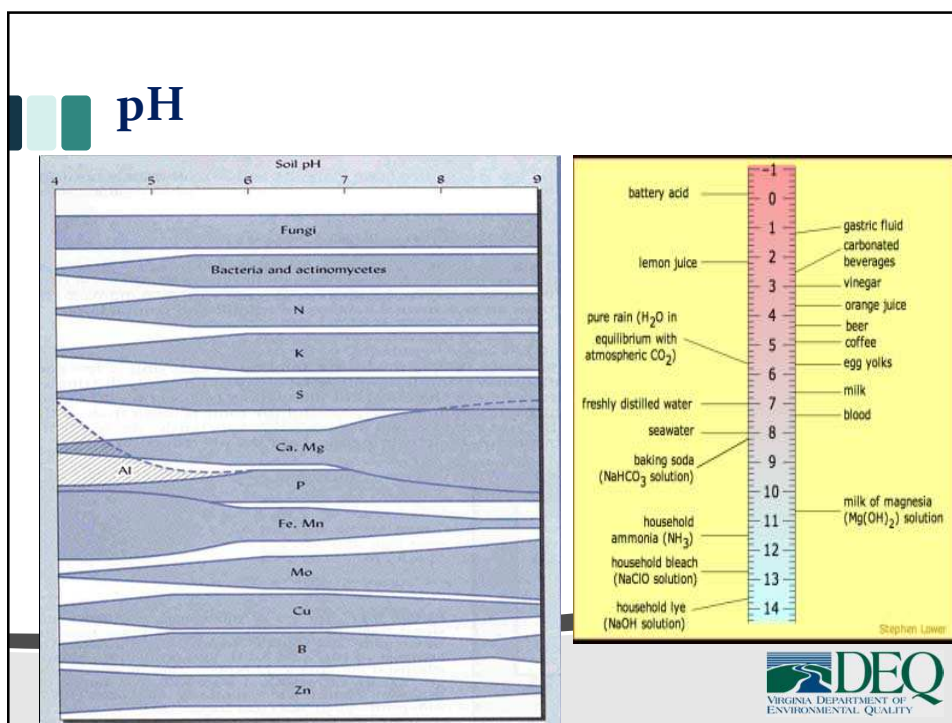
Biotic Nutrients	Nitrogen	-	Protein	Essential macro
	Sulphur	-	Protein	Essential macro
	Phosphorus	-	Protein	Essential macro
Basic Nutrients	Calcium	+	Metabolic	Essential macro
	Magnesium	+	Metabolic	Essential macro
	Potassium	+	Metabolic	Essential macro
	Sodium*	+	Metabolic	Beneficial
Minor Nutrients	Iron	+	Regulatory	Essential
	Manganese	+	Regulatory	Essential
	Copper	+	Regulatory	Essential
	Zinc	+	Regulatory	Essential
	Boron*	0	Regulatory	Essential
Incidental Nutrients	Aluminium*	+		Beneficial
	Nickel*	+		Essential
	Molybdenum	-		Essential
	Cobalt			Essential
	Silicon	0		Beneficial
	Selenium	-		Beneficial
	Chlorine*	-		Essential



a.k.a. micronutrients

\* may reach toxic/detrimental levels





# Soil Testing

- Soil texture, pH and nutrient content should be determined before application of lime and fertilizer
- Soil samples are sent for testing
- Small fee
- Saves time, money
- Will help to establish vegetation correctly

**Virginia Cooperative Extension**  
Virginia Tech • Virginia State University

Virginia Tech  
Soil Testing Laboratory  
Publication 452-125  
Revised 2014

**Soil Sample Information Sheet for  
Home Lawns, Gardens, Fruits, and Ornamentals**

*Please Print (Form expires January 2017)*

INSTRUCTIONS: See other side for sampling instructions. For a recommendation, be sure to fill in the **plant code number**. Place check marks (✓) where appropriate. Use another form for commercial crop production. Send samples, forms, and payment to Virginia Tech Soil Testing Lab, 145 Smyth Hall (MC 0465), 185 Ag Quad La, Blacksburg VA 24061, in a sturdy shipping carton weighing less than 37 pounds. Processing will be delayed if soil is not received in an official sample box. See [www.soiltest.vt.edu](http://www.soiltest.vt.edu) for more information.

Your Name: \_\_\_\_\_ Date sampled: \_\_\_\_\_  
E-mail: \_\_\_\_\_ Phone: \_\_\_\_\_ MM/DD/YY  
Mailing Address: \_\_\_\_\_  
City: \_\_\_\_\_ ZIP Code (required): \_\_\_\_\_  
County Where Soil is Located (required): \_\_\_\_\_  
Copy Report To (Consultant, etc.): \_\_\_\_\_  
Their E-mail: \_\_\_\_\_

**SAMPLE IDENTIFICATION**  
Your Sample Box Number or Name (1 to 5 digits) \_\_\_\_\_

**PLANT TO BE GROWN**  
Insert Plant Code # from list at right \_\_\_\_\_

**SOIL INFORMATION**  
Last Lime Application \_\_\_\_\_  
Months Previous \_\_\_\_\_ Pounds per 1,000 sq. ft. \_\_\_\_\_

**PLANT CODE LIST**

**Lawn: Kentucky Bluegrass, Fescue, or Ryegrass**

201 Establishing New Lawn  
202 Maintaining Lawn, Repair of Bare Spots

**Lawn: Bermudagrass, Zoysiagrass, or St. Augustine**

203 Establishing New Lawn  
204 Maintaining Lawn, Repair of Bare Spots

**Garden**

210 Vegetable Garden  
211 Flower Garden  
212 Roses

**Acid-Loving Shrubs**

240 Azaleas  
241 Andromedas  
242 Camellias  
243 Laurel  
244 Rhododendrons

**Non-Acid-Loving Shrubs and Trees**

245 Shrubs - Lilac, Forsythia, Boxwood, etc.  
246 Trees - Pine, Maple, Oak, etc.

**Fruits**

220 Apples  
221 Blackberries  
222 Blueberries  
223 Currants  
224 Gooseberries  
225 Grapes  
226 Nectarines  
227 Peaches  
228 Plums  
229 Plants  
230 Quince  
231 Raspberries  
232 Sour Cherry  
233 Strawberries  
234 Sweet Cherries

**House Plants**

250 Potted House Plants

**SOIL TESTS DESIRED AND FEES**

☐ Routine (soil pH, P, K, Ca, Mg, Zn, Mn, Cu, Fe, B, and estimated CEC) \$10.00

☐ Organic Matter - Determines percentage in soil - no recommendation given \$4.00

☐ Soluble Salts - Determines if fertilizer salts are too high \$2.00

**COST PER SAMPLE**

ROUTINE \$10.00  
ORGANIC \$4.00  
SOLUBLE \$2.00

Send in payment along with soil sample and form; make check or money order payable to "Preston, Virginia Tech."

## So, what's in that soil test report?

- Available from various labs. Usually cost \$10 to \$20 per sample for simple tests; can be much expensive. Be alert for “voodoo prescriptions” !
- Typically report pH, OM, and dilute acid extractable P, Ca, Mg, K and Na. You can also ask for soluble salts and extractable micronutrients (Zn, Mn, Fe, etc.)



## A Typical Report

SAMPLE HISTORY										
Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Freq.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
OCF11	4463	Orchardgrass/Fescue-Clover Pasture (40)		18+		40B2 100				III

LAB TEST RESULTS (see Note 1)										
Analysis	P (lb/A)	K (lb/A)	Ca (lb/A)	Mg (lb/A)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)	S.Salts (ppm)
Result	9	95	1408	209	1.2	10.3	0.3	4.4	0.5	
Rating	L+	M-	M+	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.7	6.21	5.6	20.1	79.9	62.5	15.3	2.2	3.6

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Lbs/acre = lb/A

ppm (pounds per million) → 1 acre soil = 2 million lbs

Zn 1.2 ppm → 2.4 lb/A



## Example of Fertilizer Recommendation

### FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Orchardgrass/Fescue-Clover Pasture (40)

Lime, TONS/AC		Fertilizer, lb/A		
Amount	Type	N	P2O5	K2O
1	AG	50	40	50

825. If stand contains less than 25 per cent clover, apply 40-60 lbs N/A.

131. If additional production is needed later on, apply 40 to 60 lbs/A of N during the grazing season. If you are planning to overseed a legume into the stand, omit the N recommendation.

122. P2O5 and K2O recommendations are for annual application. However, rates can be doubled and applied every other year if desired.



## Soil Amendments

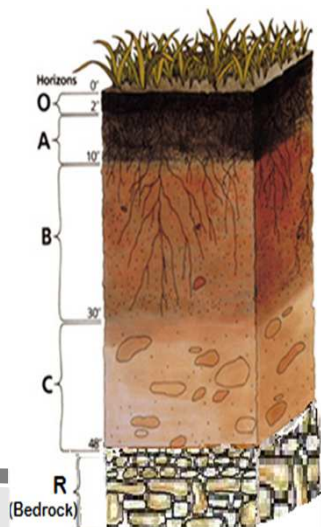


**Need to be  
based on soil  
analysis!**





## Soil Organic Matter (Compost)







Also known as ***Humus***. It is the dark brown to black complex decomposition product of organic matter turnover in soils. It is typically reported as ***organic matter content*** in soil testing programs. In a soil profile it typically occurs in the O profile (O = Organic) and is leached out into the A profile.



## Soil Organic Matter (Compost)


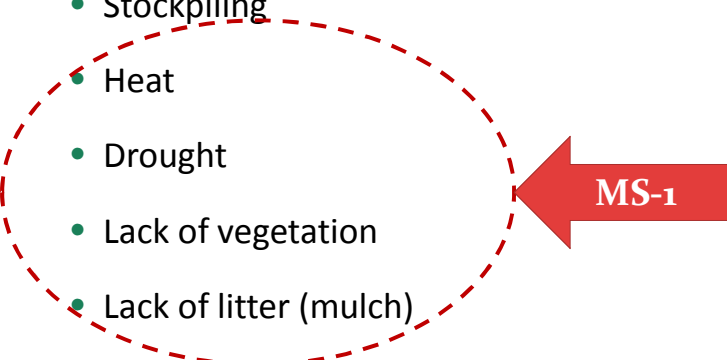
Organic Matter in the soil:

- Opens soil up: increases infiltration 
- Binds soil particles together: decreases erosion 
- Binds nutrients: improves fertility 
- Feeds microorganisms: improves overall soil health 



## Enemies of Soil Organic Matter

- Stockpiling
- Heat
- Drought
- Lack of vegetation
- Lack of litter (mulch)
- Texture (sandy soils)



## 4. Soil Compost Amendments

Use in with SW BMPs

- Simple Rooftop Disconnections
- Filter Strips
- Grass Channels

**To improve infiltration  
of C and D soils**

